Why just THROW the ball to Her?
When you can BE THE BALL for Her?

Go from traditional throw and catch to so much more...

» *Play with Her even when you cannot get aroud that well.*

» *Give Her more of a challenge.*

Stray Pooch

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Presented by:

Allen Clark ◆ Kieu Dinh ◆ Bilal Haroon ◆ Richard Hosch

Abstract:

They say dog is man's best friend; for the elderly this is exceptionally true. Finding a way to allow those who have pets but are unable to interact with them do to limited mobility is the whole goal of the Stray Pooch Dog Toy. The Stray Pooch Toy itself comprises of micro-controllers, two hobby motors, a gearbox, and a single axle support frame. To be included in the overall process is the XBee transmitter and receiver set; this allows the toy to be controlled by a laptop or desktop computer system. For the software, there are two programs: one for the micro-controller and the other for the computer to send commands to the ball via the XBee set (i.e. push the "s" button for forward movement and the "w" button for the opposite direction). It is the idea that this new concept of interacting with a dog will work on an acceptable level given the right breed combination, (meaning the size of toy is not intimidating to the dog,) and some encouragement from the dog's owner. Interest in the Stray Pooch design has been addressed among family and friends of the designers and improvements have been acknowledged and not yet implemented based on the comments provided to the designers.

Features and Usability:

This toy was designed to have the most efficient means of motion, spherical. This will allow the user to have control without planning a complex route to control the toy. An obvious feature and the primary reason for the overall design is that the toy is remote controlled from a computer. This provides those with limited mobility an easier way to play with their beloved pets. The prototype is designed to have all electronics within the spherical shell preventing the beloved pet from destroying the toy. Talking to the family and friends of the design group prompted a consensus: the prototype, and the concept that surrounds it, looks promising, however, they would not purchase the toy as it is now. Some key features that should be looked into are as follows: have a user-friendly power switch and look into a plug and play design.

Productibility:

The construction of this toy is fairly simple and easy to mass-produce. One of the requirements though would be investing more time for research and development to reduce the size of the toy from 11.5 inches to say eight or nine inches along with designing a less sophisticated design for the support and housing of the toy's internal components. A bill of materials for the current prototype will be presented later on, however, this design will have a price range, for the parts only, of $100.00 to $126.00 depending on if the parts were bought at bulk. Again, this is a prototype design for proof of concept and it is recommended that further development along with stricter cost analysis is needed to build a profitable design for marketability.

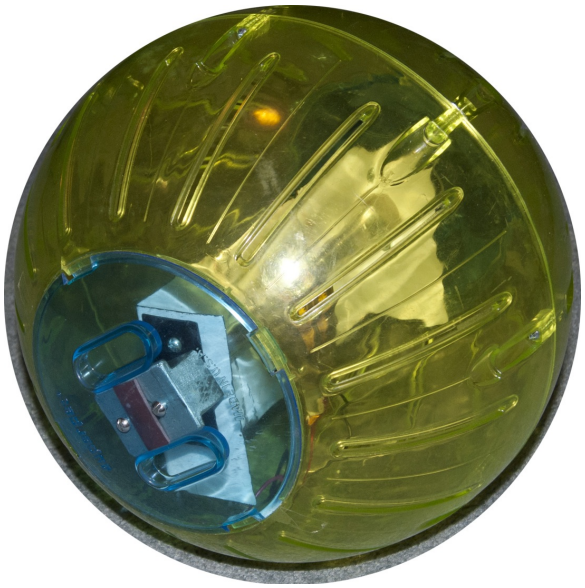
User Manual:

Disclaimer: All topics discussed in this section are general ideas of what could be in here, however, this product is not yet ready for market and it should be noted that when it is, further elaboration is needed for the user manual.

Instructions

1. Check contents to ensure that everything is present.
2. Insert installation disk and follow the auto run instructions (if problems with auto run occur follow the directions below).
    a. Navigate to the CD-ROM drive
    b. Double click setup.exe
3. Enjoy

Contents



11.5” Stray Pooch Dog Toy

Installation Disk

Xbee Transmitter w/ USB adaptor

Mini USB Cable

Trouble Shooting

Problem	Possible Fixes
Ball does not respond to commands from computer	• Ensure that the battery is installed • Restart computer • Reinstall software • Press restart button
Ball is not rolling even though the motors are moving	• There might be a problem with the gearbox, therefore, for this and any other problems not listed, visit the following website to get in contact with the manufacturer: • Tech Support Page

Industry Standards, Patent Research, and Liability:

Given this design uses a non-rechargeable battery, industry standards for the toy are not applicable, however, if the toy did have the ability to recharge itself, then proper labeling would be needed on the charger. This label would inform the users to such things as input and output voltages and currents. Warning symbols might tell the user to properly dispose of the charger, and caution statements that inform the user to only plug the toy into a grounded outlet. Further elaboration involving the development of this portion would be needed once a marketable product is made.

Good news, nobody else, from the research conducted, has developed the same idea as the Stray Pooch Design Team did. The following describes, along with provides links to the patents themselves, ideas that have similar concepts as the Stray Pooch:

- Training Guidance System-- Patent No.: US 7,861,676 B2
- Pet Entertainment System--Pub. No.: US 2008/0282988 A1

The following are possible liability statements to incorporate into the user manual once a consumer product is developed:

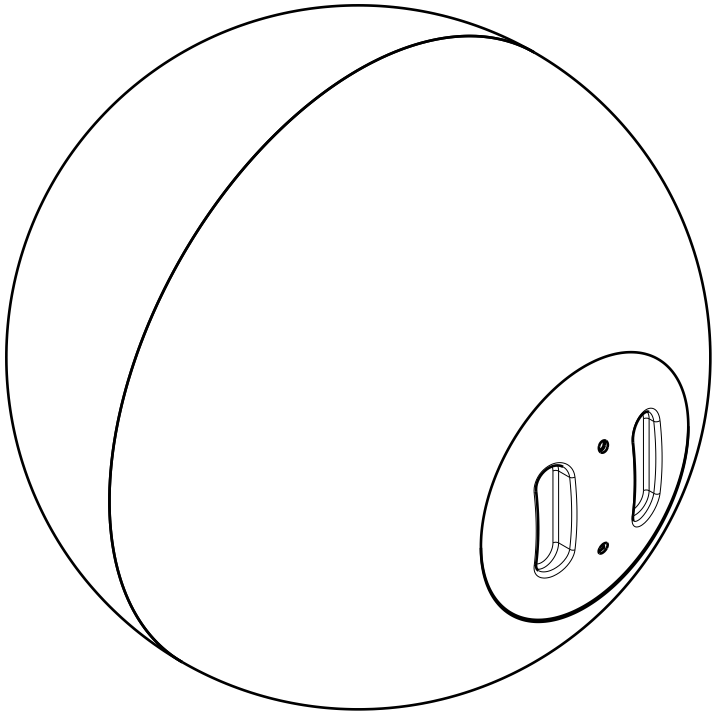
- In the following "we, us, the group" indicates all who participated in the design and fabrication of the Stray Pooch Dog Toy.
- By "pet" we mean a dog or a cat.
- By "toy" we mean the Stray Pooch Dog Toy.
- We are not responsible for lost pets.
- This toy is designed for appropriate use. This means:
    - Playing with a pet in a manner that does not endanger the pet owner or the pet itself.
    - No liability can be incurred due to, any incidents or damages that occur while using this toy in any unintended function.
- Any alterations done on the toy, either mechanical or electrical, will result in freeing us from any liability.

Figures:

Assembly Drawings:

These drawings are the working views of the toy itself. All models were created in CATIA V5R18, a computer-aided 3D designing software that allows visualization of virtual models in real-time. These assembly drawings were used to create multiple working prototypes of the toy.

The first sheet shows a completely assembled toy, as it will appear to the pet. The second sheet shows an exploded view of toy with each part labeled. The remaining sheets show each of the 3 parts that were manufactured.



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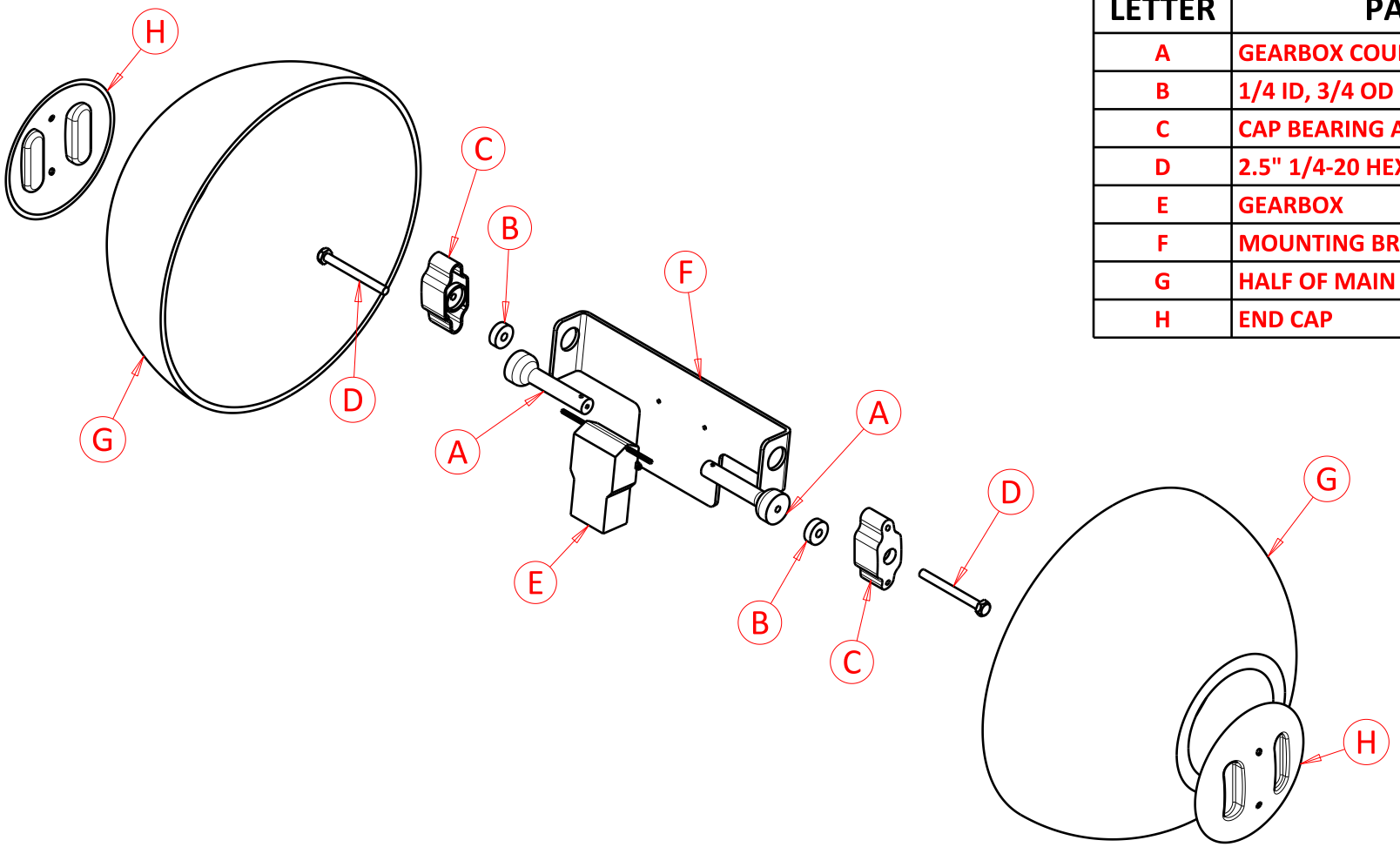
STRAY POOCH

DRAWING TITLE

DOG TOY

DRAWN BY: Richard Hosch	DATE: 11/10/2011	SIZE: A	DRAWING NUMBER: MDS-001	REV: 2
CHECKED BY	DATE			
DESIGNED BY: STRAY POOCH	DATE: 08/15/2011	SCALE: 1:3	WEIGHT(kg)	SHEET: 1/5



LETTER	PART NAME
A	GEARBOX COUPLING
B	1/4 ID, 3/4 OD RADIAL BEARING
C	CAP BEARING ASSEMBLY
D	2.5" 1/4-20 HEX BOLT
E	GEARBOX
F	MOUNTING BRACKET
G	HALF OF MAIN BALL
H	END CAP

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STRAY POOCH

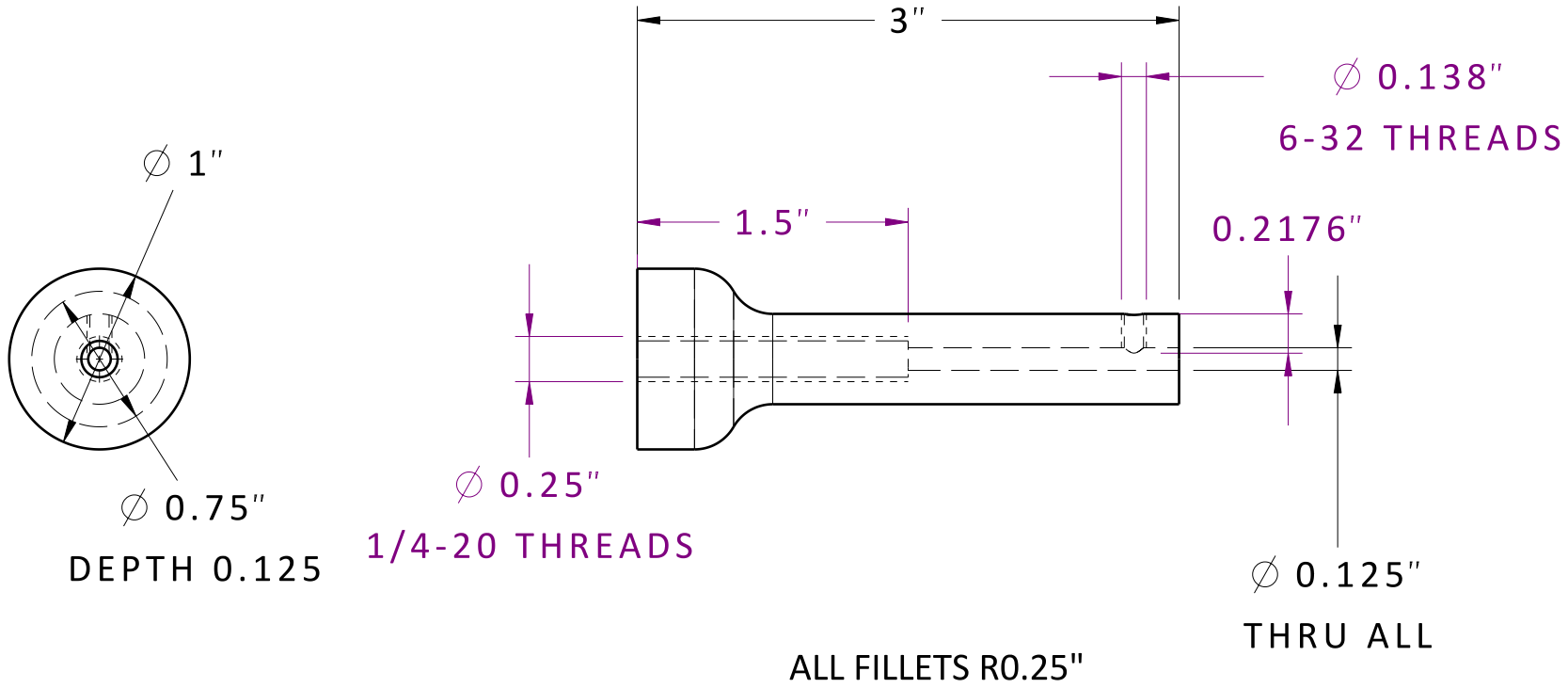
DRAWING TITLE

DOG TOY

DRAWN BY: Richard Hosch	DATE: 11/10/2011		
CHECKED BY	DATE	SIZE: A	DRAWING NUMBER: MDS-001 / REV: 2
DESIGNED BY: STRAY POOCH	DATE: 08/15/2011	SCALE: 1:5	WEIGHT(kg) / SHEET: 2/5

A

GEARBOX COUPLING



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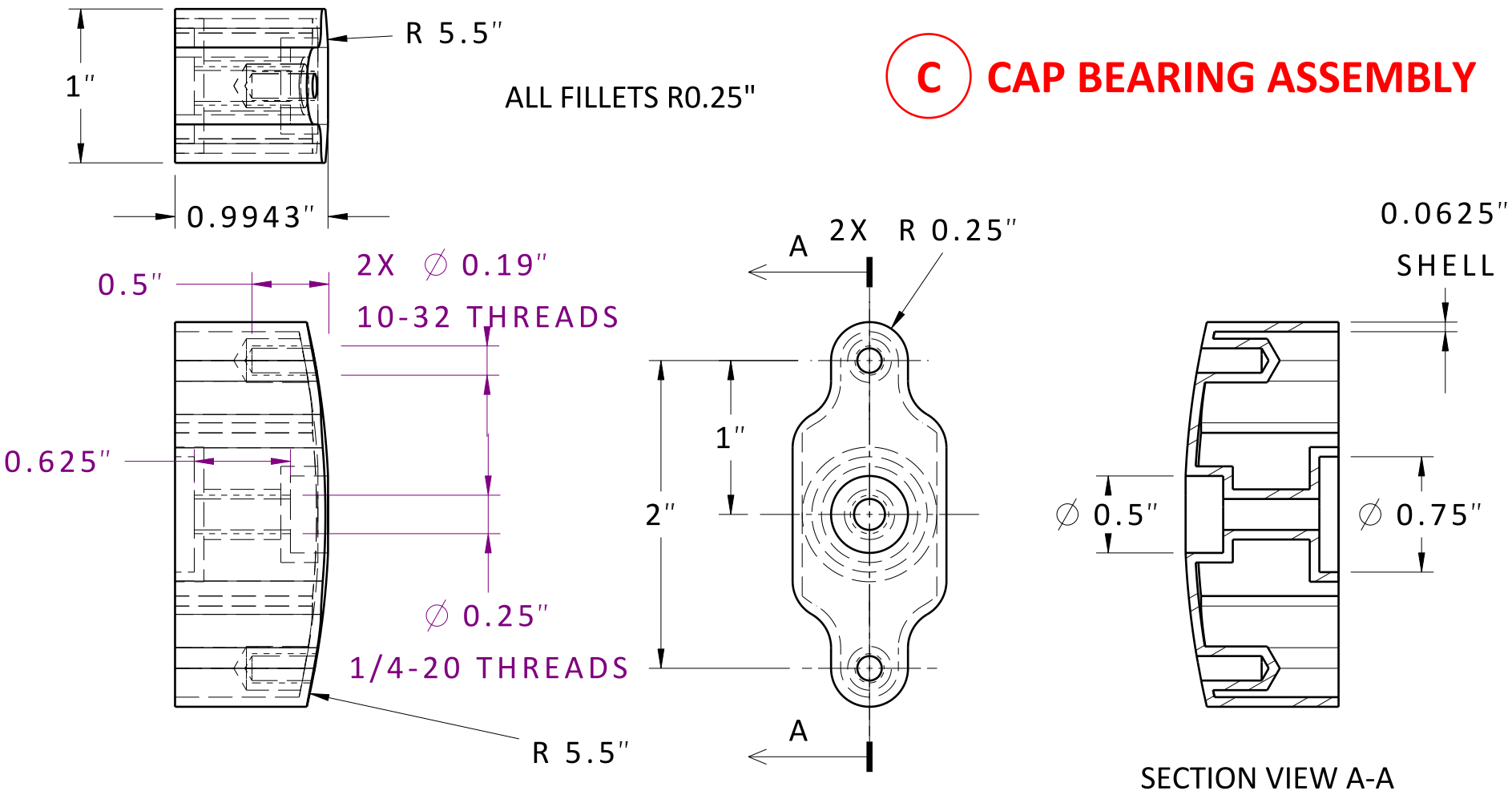
DRAWN BY: Richard Hosch	DATE: 11/10/2011
CHECKED BY	DATE
DESIGNED BY: STRAY POOCH	DATE: 08/15/2011

STRAY POOCH

DRAWING TITLE: DOG TOY

SIZE	DRAWING NUMBER	REV
A	MDS-001	2

SCALE	WEIGHT(kg)	SHEET
1:1		3/5



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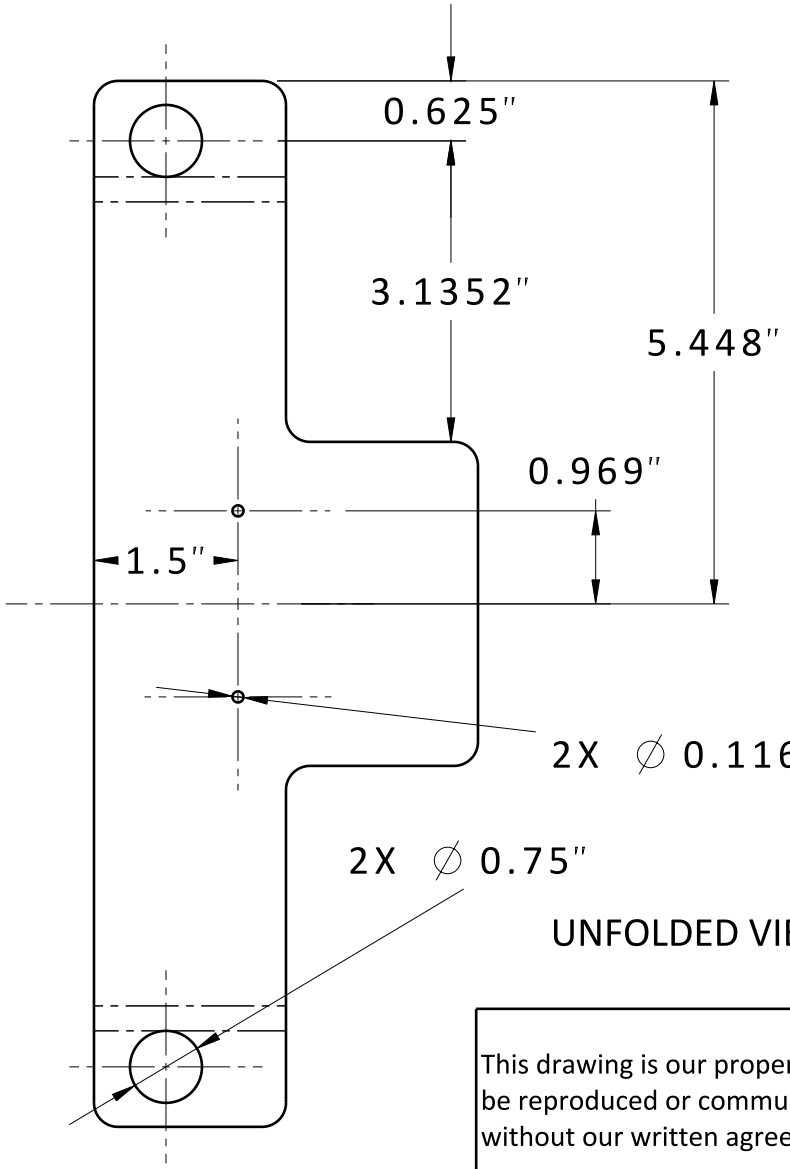
STRAY POOCH

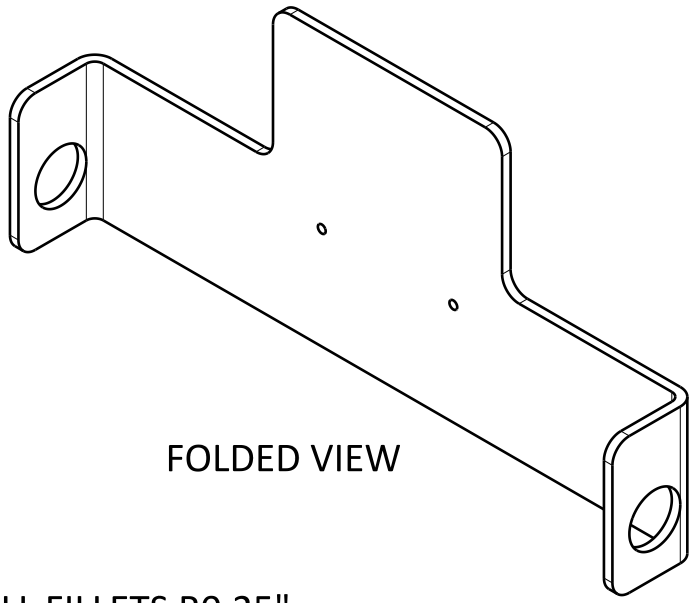
DRAWING TITLE

DOG TOY

DRAWN BY: Richard Hosch	DATE: 11/10/2011	SIZE: A	DRAWING NUMBER: MDS-001	REV: 2
CHECKED BY	DATE			
DESIGNED BY: STRAY POOCH	DATE: 08/15/2011	SCALE: 1:1	WEIGHT(kg)	SHEET: 4/5



UNFOLDED VIEW



FOLDED VIEW

ALL FILLETS R0.25"
BEND RADIUS 0.2602"
MATERIAL: ALUMINUM

F **MOUNTING BRACKET**

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STRAY POOCH

DRAWING TITLE
DOG TOY

DRAWN BY: Richard Hosch	DATE: 11/10/2011	SIZE: A	DRAWING NUMBER: MDS-001	REV: 2
CHECKED BY	DATE			
DESIGNED BY: STRAY POOCH	DATE: 08/15/2011	SCALE: 1:2	WEIGHT(kg)	SHEET: 5/5

Support Structure:

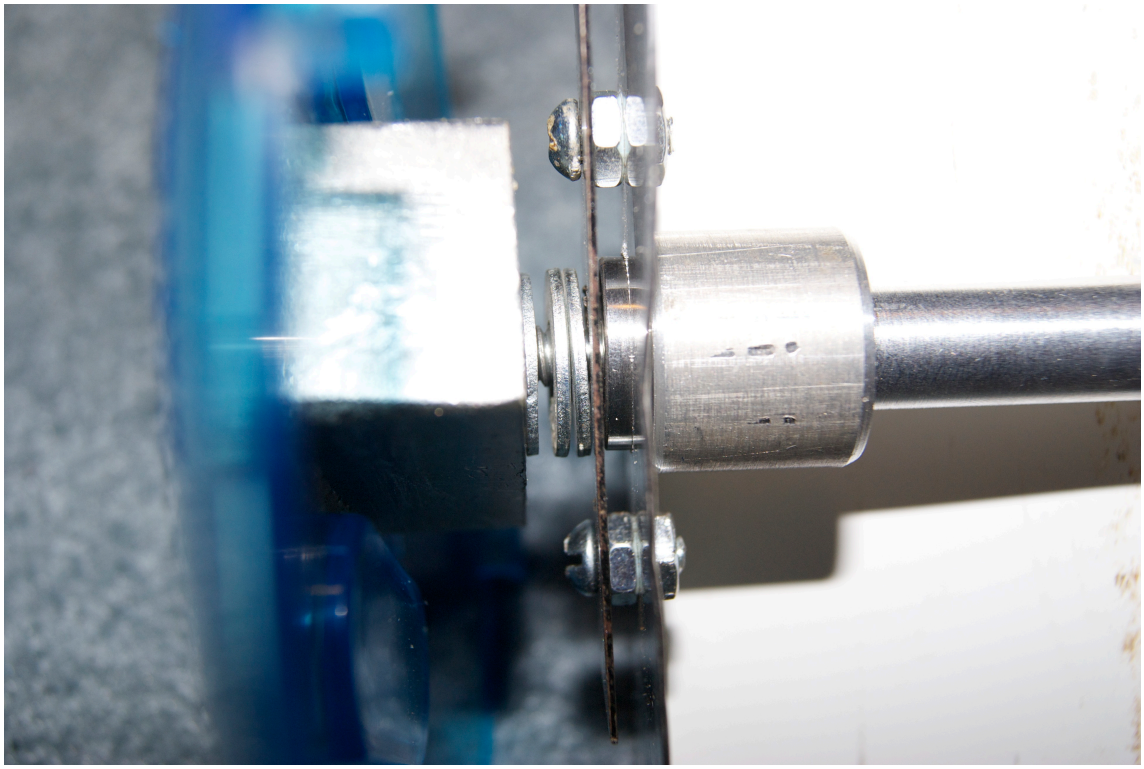


Figure 1 -- Photo of Gearbox Coupling, Cap Bearing Assembly and End Cap

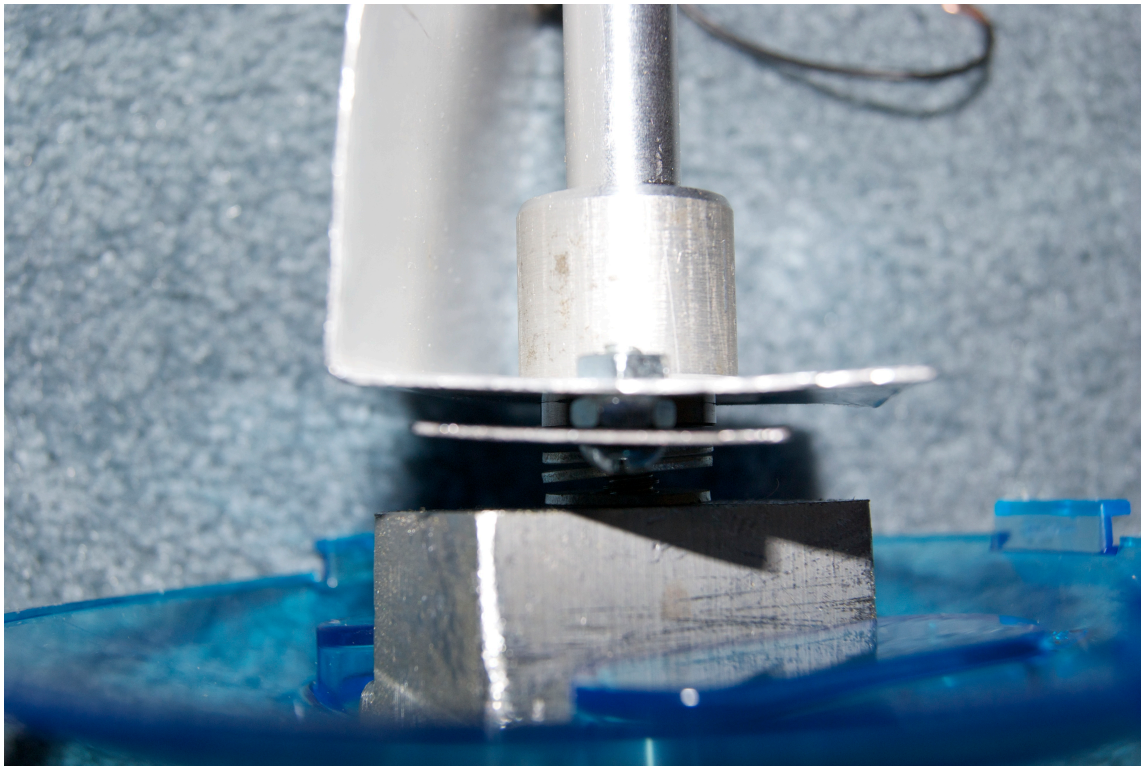


Figure 2 -- Side view of End Cap, Cap Bearing Assembly and Gearbox Coupling

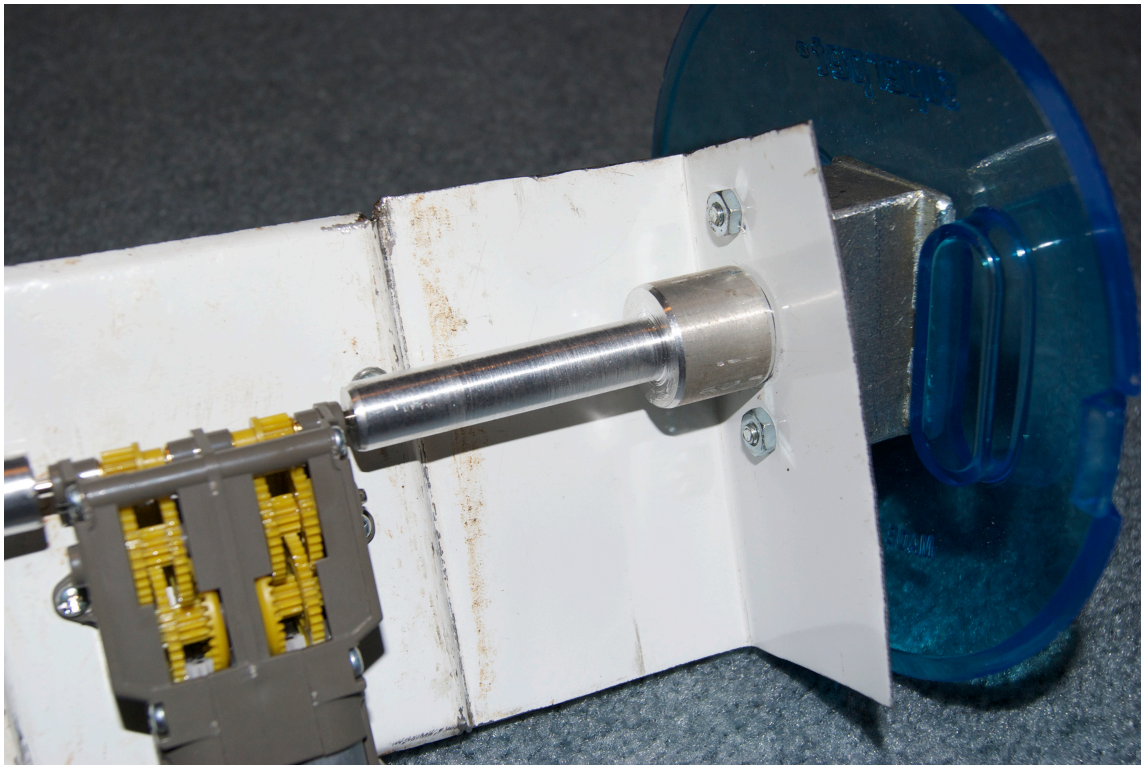


Figure 3 -- Larger view of End Cap with Gearbox Assembly

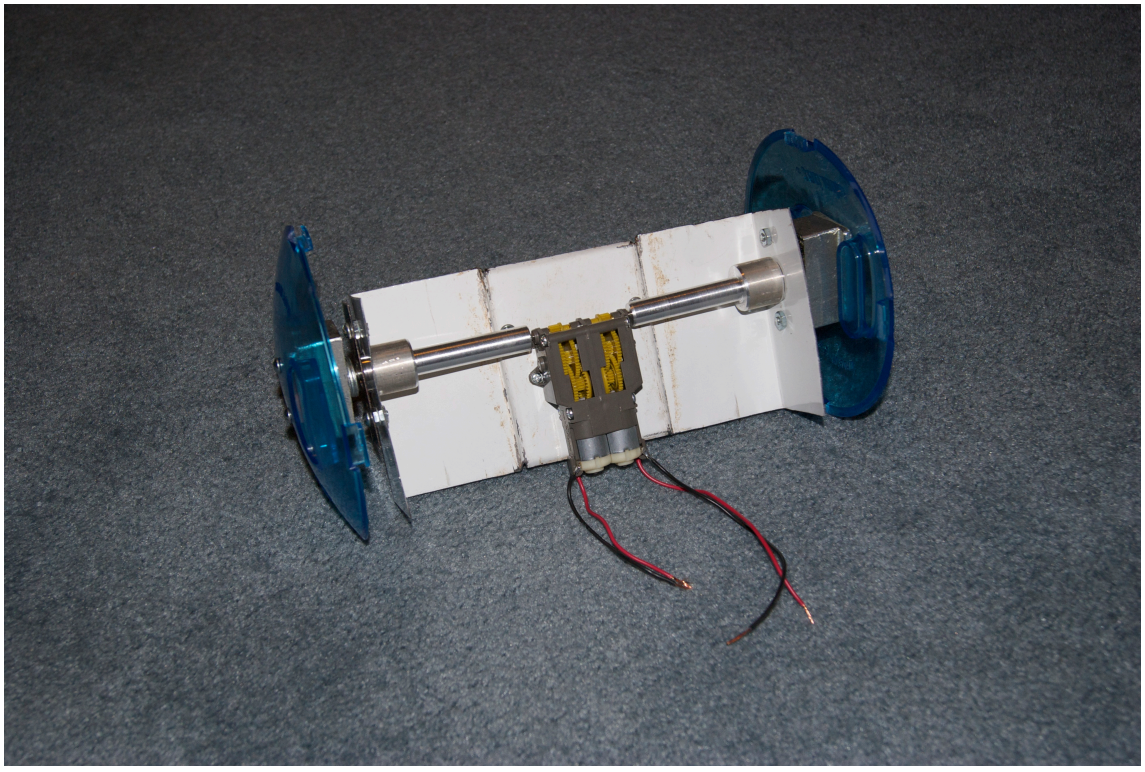


Figure 4 -- Complete view of Gearbox Assembly without circuit board attached

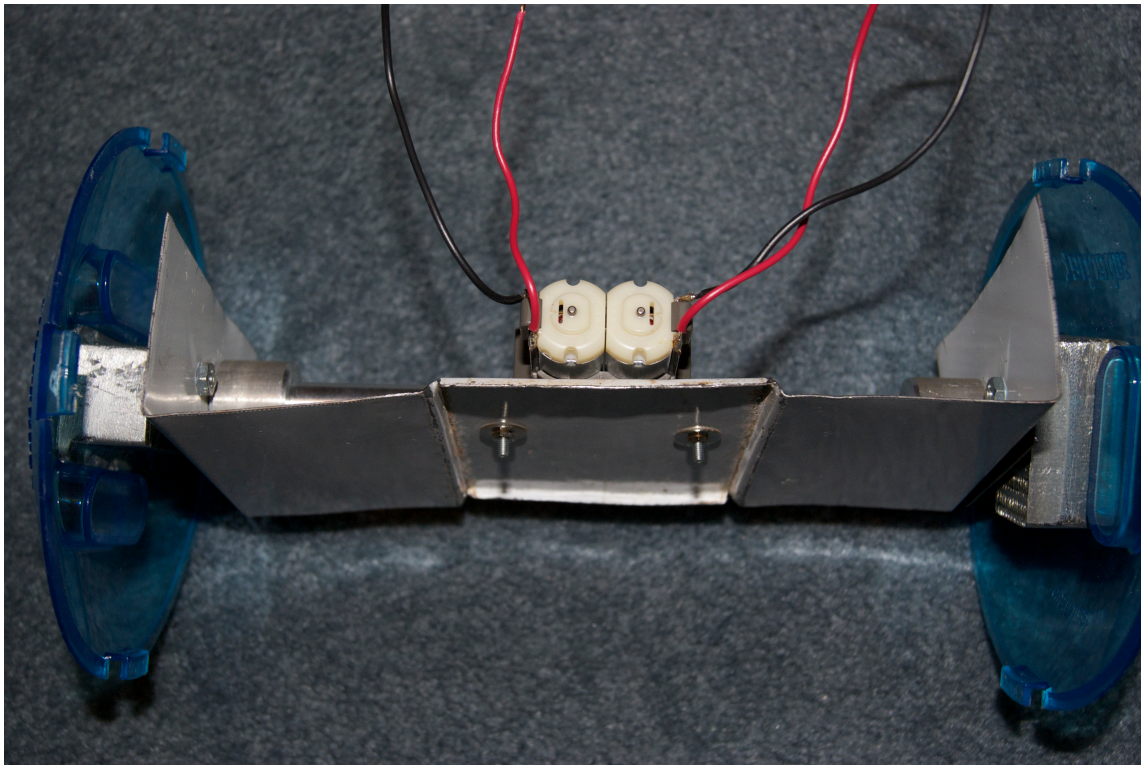
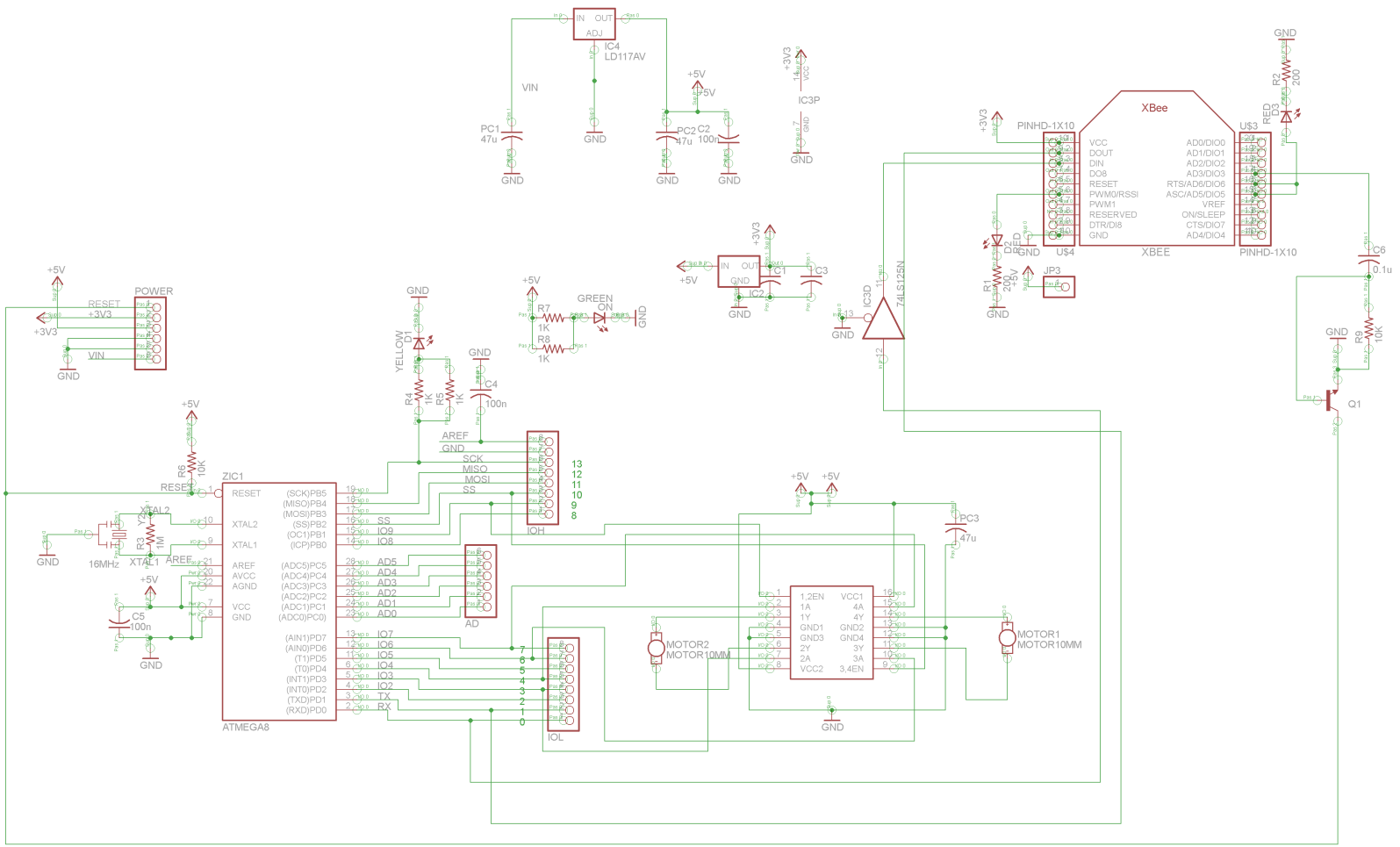


Figure 5 -- Rear view of Gearbox Assembly showing attachment of the gearbox itself

Schematics:

Three major versions of the electrical schematics were generated. The first version created was a complete mockup of the Arduino Microcontroller design, the motor driver circuit that had been created for early testing as well as an XBee adapter circuit. This schematic was never produced for a circuit board, as there were several unneeded items. This version was striped down considerably and was eventually replaced with "version 3.2." This version striped the original design of everything except the microcontroller, the buffer for the XBee and the motor driver. Headers were added to allow testing of the circuit, giving the schematic a rather chunky size. In the latest version, "version 3.3" the headers were removed as well as the buffer since it was determined through testing this buffer did not affect the readings received from the XBee module.

Two versions are shown below, version 3.2 and 3.3.



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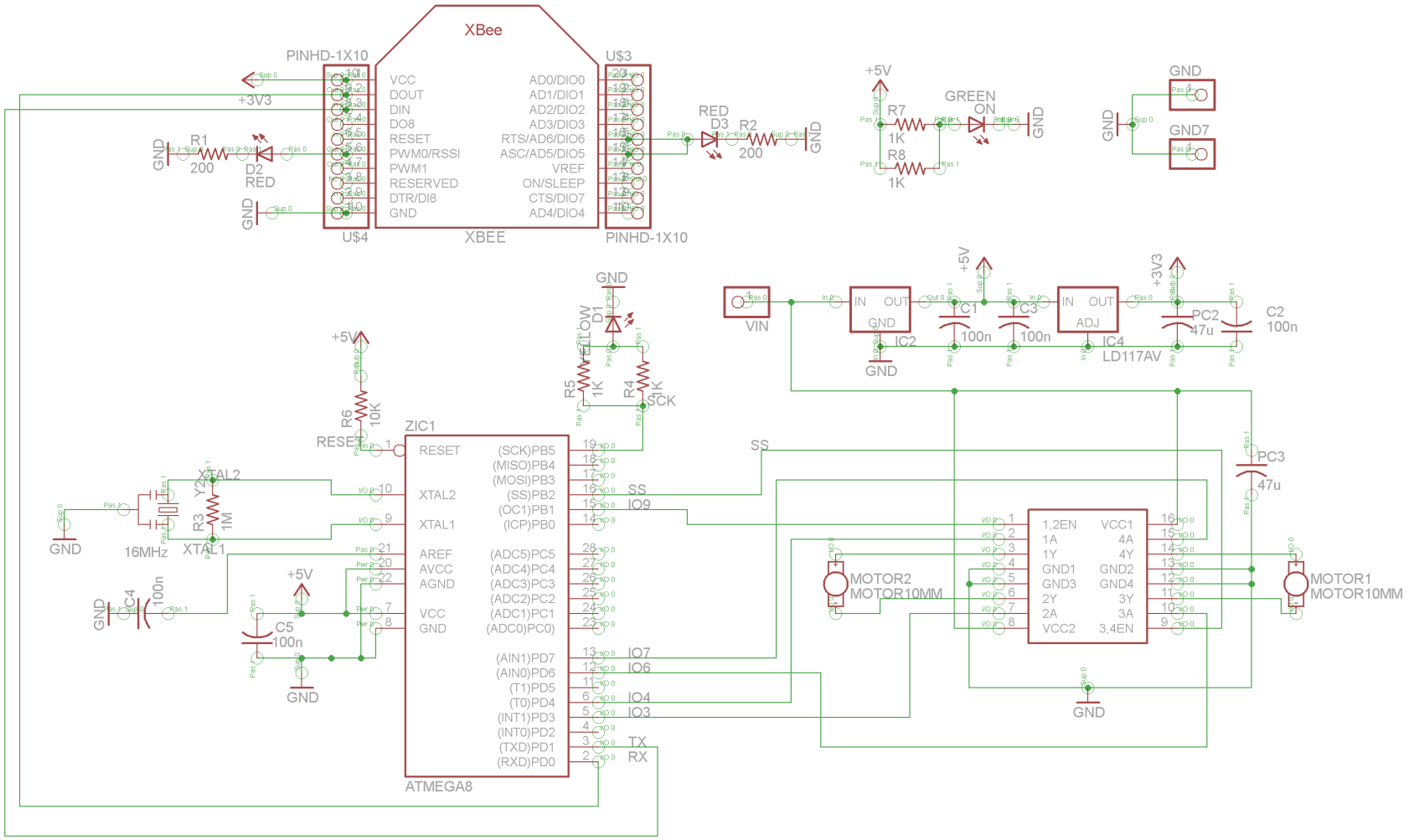
STRAY POOCH

DRAWING TITLE

DOG TOY SCHEMATIC

DRAWN BY: Richard Hosch	DATE: 10/05/2011	SIZE: A	DRAWING NUMBER: MDE-001
CHECKED BY	DATE		REV: 2
DESIGNED BY: STRAY POOCH	DATE: 08/15/2011		SHEET: 1/1



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STRAY POOCH

DRAWING TITLE

DOG TOY SCHEMATIC

DRAWN BY: Richard Hosch	DATE: 11/10/2011		
CHECKED BY	DATE	SIZE: A	DRAWING NUMBER: MDE-001 / REV: 3
DESIGNED BY: STRAY POOCH	DATE: 08/15/2011		SHEET: 1/1

Codes:

Software was produced to make this toy functional, one for the computer and one for the toy itself. All software was written in the C language due to its relative ease of learning and versatility. The toy software was written in an Arduino designing environment using the Arduino Software written by the open source group of the same name available at the Arduino Source page. This environment runs entirely within C and uses a serial connection to push the user-created software to the microcontroller. The computer software was generated using the Processing environment. Again, this is an open source environment designed to allow users to generate C programs for deployment on multiple platforms. It is capable of using the USB and serial ports on any machine as an input and output means of communication. This capability was exploited to allow the XBee module (which connects to a USB port) to communicate with the toy wirelessly as if it were a directly attached peripheral.

Computer Software:

```
/*This is the computer software generated in Processing.
As W is pressed on the keyboard, the speed of the motor will increase in the forward direction.
Pressing S will increase in the reverse direction.*/

import  processing.serial.*;

Serial port;

int counter = 0;  //Defines a counter and stores 0
String data = "\r"; //Defines the string “data” and stores a carriage return

void setup()
{
   size(100,100);
   println(Serial.list());

/*The first port in the serial list on the computer is always the last item to be connected.
For the purposes of this demonstration, Serial.list()[0] is used, the first port is opened.*/
   port = new Serial(this,Serial.list()[0],9600);
}

void draw()
{
   rect(25, 25, 50, 50); //Draws arbitrary box within window.


 if (keyPressed == true)
 {

/*This loop is performed only when the “W” key is pressed.*/
   if( key == 'w')
   {
     counter++;
     delay(100);
//Once the counter reaches 256, it will become to 255(since 255 is the max). This will cap the speed at 256
     if ( counter == 256)
     {
       counter = 255;
     }
   }

/*This loop is performed only when the “W” key is pressed.*/
   if (key == 's')
   {
     counter--;
     delay(100);
//Once the counter reaches -256, it will become to -255(since -255 is the max). This will cap the speed at -256
     if ( counter == -256)
     {
       counter = -255;
     }
   }
 }

 else
 {
    counter = 0;
 }

   fill(counter);
   data = ""+counter+"\r";  //Generates string to send over serial connection
   port.write(data); //Sends data string through the serial connection
}
```

Toy Software:

```
/*This is the toy software written in Arduino. It will convert the incoming bytes into integer values which will control the speeds of the motor.*/

#define switchPin 2         //Switch input
#define motor1Pin 3         //Motor 1 leg 1 (pin 3)
#define motor2Pin 4         //Motor 1 leg 2 (pin 6)
#define motor3Pin 6         //Motor 2 leg 1 (pin 11)
#define motor4Pin 7         //Motor 2 leg 2 (pin 14)
#define enable1Pin 9        //Motor1 enable pin
#define enable2Pin 10       //Motor2 enable pin
#define ledPin 13           //Reset LED

char value_read[5];         //Define char array for reading serial values
int speed_value = 0;        //Define an initial speed

void setup()
{
  Serial.begin(9600);   //Turn on the Serial Port at 9600 bps
  Serial.flush();       //Clear all serial inputs

/*Set all the other pins you're using as outputs*/
  pinMode(motor1Pin, OUTPUT);
  pinMode(motor2Pin, OUTPUT);
  pinMode(motor3Pin, OUTPUT);
  pinMode(motor4Pin, OUTPUT);
  pinMode(enable1Pin, OUTPUT);
  pinMode(enable2Pin, OUTPUT);
  pinMode(ledPin, OUTPUT);

/* Blink the LED 3 times. This should happen only once. If you see the LED blink three times, it means that the module reset itself, probably because
the motor caused a brownout or a short. */
     blink(ledPin, 3, 100);
}

void loop()
{
  int x;        //Sets storage variable for Serial.read()
  int i = 0;    //Defines a counter for while loop

/*As long as the incoming serial byte is not a carriage return or new line the values will be stored in the value_read array*/
  while(((x = Serial.read()) != 13) && ( x != 10 ))
  {
    if( x != -1)                //If the incoming byte is not -1 (no value)
    {
      value_read[i++] = x;      //Stores the incoming number in char array
    }
    value_read[i] = '\0';       //Sets last value (carriage return) to null
  }

/*Converts the char array to integer value*/
  speed_value = atoi(value_read);

/*If speed value greater than zero, the direction of motors will spin forward*/
  if( speed_value > 0 )
  {
    analogWrite(enable2Pin, speed_value);
    digitalWrite(motor3Pin, HIGH);              //Set leg 1 of the Motor2 high
    digitalWrite(motor4Pin, LOW);               //Set leg 2 of the Motor2 low
    analogWrite(enable1Pin, speed_value);
    digitalWrite(motor1Pin, HIGH);              //Set leg 1 of the Motor1 high
    digitalWrite(motor2Pin, LOW);               //Set leg 2 of the Motor1 low
  }

/*If speed value less than zero, the direction of motors will spin backward*/
  if (speed_value < 0 )
  {
    analogWrite(enable2Pin, speed_value*-1);
    digitalWrite(motor3Pin, LOW );              //Set leg 1 of the Motor2 high
    digitalWrite(motor4Pin, HIGH);              //Set leg 2 of the Motor2 low
    analogWrite(enable1Pin, speed_value*-1);
    digitalWrite(motor1Pin, LOW);               //Set leg 1 of the Motor1 high
    digitalWrite(motor2Pin, HIGH);              //Set leg 2 of the Motor1 low
  }

/*If no key is pressed, no movement will occur*/
  if( speed_value == 0 )
  {
    digitalWrite(enable2Pin, LOW);
    digitalWrite(enable1Pin, LOW);
  }
}

/*Blinks the LED signifying restart*/
void blink(int whatPin, int howManyTimes, int milliSecs)
{
  int i = 0;
  for ( i = 0; i < howManyTimes; i++)
  {
    digitalWrite(whatPin, HIGH);
    delay(milliSecs/2);
    digitalWrite(whatPin, LOW);
    delay(milliSecs/2);
  }
}
```

Bill of Materials:

For H-Bridge Schematic Version 3.2:

BILL OF MATERIALS FOR H-BRIDGE SCHEMATIC								
REF.	QTY	PART DESCRIPTION	MFG.	PART NO.	SOURCE	PRICE PER UNIT	PRICE PER 100	
XBEE	1	XBee DigiMesh 2.4 Module (any XBee modem will function)	Digi	XB24-DMWIT-250	Mouser Electronics	$19.00	$19.00	DATASHEET
ZIC1	1	8-bit ATMEGA microcontroller	Atmel	ATMEGA8-16PU	Mouser Electronics	$ 2.61	$ 2.08	DATASHEET
	1	28-pin IC socket	3M	4828-3004-CP	Mouser Electronics	$ 0.31	$ 0.21	DATASHEET
IC3	1	5V compliant buffer chip	Texas Instruments	SN74AHC125N	Mouser Electronics	$ 0.56	$ 0.30	DATASHEET
	1	14-pin IC socket	3M	4814-3004-CP	Mouser Electronics	$ 0.13	$ 0.09	DATASHEET
IC1	1	36V Quad Half H-Bridge	Texas Instruments	SN754410NE	Mouser Electronics	$ 2.30	$ 1.66	DATASHEET
	1	16-pin IC socket	3M	4816-3000-CP	Mouser Electronics	$ 0.13	$ 0.09	DATASHEET
Y2	1	16 MHz Resonator (16 MHz crystal may be used with caps)	ECS	ZTT-16.00MX	Mouser Electronics	$ 0.50	$ 0.35	DATASHEET
Q1	1	BJT NPN Transistor (any TO-92 packaging will do)	Fairchild	FJN3303FBU	Mouser Electronics	$ 0.20	$ 0.15	DATASHEET
IC2	1	5V Linear Voltage Regulator	Fairchild	LM7805CT	Mouser Electronics	$ 0.54	$ 0.40	DATASHEET
IC4	1	3.3V Low Drop Out Voltage Regulator	Microchip Technology	MCP1700-3302E/TO	Mouser Electronics	$ 0.40	$ 0.28	
R1,R2	2	200 Ohm resistor	KOA Speer	CF1/4C201J	Mouser Electronics	$ 0.15	$ 0.10	DATASHEET
R3	1	1 Mohm resistor	Xicon	299-1M-RC	Mouser Electronics	$ 0.10	$ 0.06	DATASHEET
R4,R5,R7, R8	4	1 Kohm resistor	Xicon	291-1.5K-RC	Mouser Electronics	$ 0.10	$ 0.05	DATASHEET
R6,R9	2	10 Kohm resistor	Xicon	291-10K-RC	Mouser Electronics	$ 0.10	$ 0.05	DATASHEET

BILL OF MATERIALS FOR H-BRIDGE SCHEMATIC								
REF.	QTY	PART DESCRIPTION	MFG.	PART NO.	SOURCE	PRICE PER UNIT	PRICE PER 100	
C1 - C6	6	0.1 uF (100nF) capacitor	Xicon	140-50V5-104Z-RC	Mouser Electronics	$ 0.28	$ 0.16	DATASHEET
PC1 - PC3	3	47 uF capacitor	Xicon	140-MLNP10V47-RC	Mouser Electronics	$ 0.35	$ 0.27	DATASHEET
POWER & AD	2	6-pin header	3M	929870-01-06-RA	Mouser Electronics	$ 0.71	$ 0.59	DATASHEET
IOL & IOH	2	8-pin header	3M	929870-01-08-RA	Mouser Electronics	$ 0.95	$ 0.75	DATASHEET
PINHD	2	10-pin header (2mm)	Harwin	M22-7131042	Mouser Electronics	$ 1.60	$ 0.99	DATASHEET
					TOTAL PRICE:	$36.93 PER UNIT	$31.61 PER 100	

For Assembly Drawings:

BILL OF MATERIALS FOR DOG TOY ASSEMBLY DRAWINGS					
REF.	QTY.	PART DESCRIPTION	SOURCE	PRICE	
A	2	Manufactured from radial aluminum	The Yard	$2.50	per lbs.
B	2	1/4 ID 3/4 OD Radial Ball Bearing	BRC Bearing	$3.92	per unit
C	2	Manufactured from stock aluminum	The Yard	$2.50	per lbs.
D	2	2.5" 1/4 Hex Bolt	Ace Hardware	$0.20	per unit
E	1	Gearbox	Sparkfun	$19.99	per unit
F	1	Manufactured from sheet aluminum	The Yard	$2.50	per unit
G-H	1	Plastic Hamster Ball	PetsMart	$19.99	per unit
UNLISTED	2	0.25" 6-32 Machine Screw	Ace Hardware	$0.04	per unit
UNLISTED	4	0.5" 10-32 Machine Screw	Ace Hardware	$0.05	per unit
			TOTAL PRICE:	$60.72	PER UNIT

For Computer Hardware:

BILL OF MATERIALS FOR COMPUTER HARDWARE				
QTY.	PART DESCRIPTION	MFG.	SOURCE	PRICE PER UNIT
1	Xbee Adapter for Client Computer	SparkFun	SparkFun Electronics	$24.95
1	USB Cable	Bytecc	Newegg.com	$2.99
			TOTAL PRICE:	$27.94 PER UNIT

Bottom Line:

BILL OF MATERIALS FOR DOG TOY	
TOTAL COST OF ELECTRONICS	$36.93
TOTAL COST OF MECHANICAL	$60.72
OTHER HARDWARE	$27.94
TOTAL COST OF MACHINE	**$125.59**

Wrap-Up:

This toy was initially designed to give those who have to travel a means to play with their beloved pets via the Internet. At first we, the Stray Pooch Dog Toy group, were making great strides at accomplishing this goal during the first semester of the senior design class. We established proof of concepts for both the wireless communications, between the toy and a joystick, and an intranet website that streamed live video feed. Then the second semester hit; which ushered in reality for our group. One of the first problems: the construction of the toy itself. We realized that the prototype developed for the first semester was inadequate structurally and needed redesigning to be more effective at supporting the inner workings of the toy and providing an axis of rotation. The next problem that set before us was updating the programming to allow a computer to act as the joystick for the ball. This proved exceptionally difficult for our group since the level of programming experience for the group was minimal at best.

From our initial design, things had to be cut due to time restraints: it is here that should be mentioned, given more time, the original concept of the Stray Pooch Dog Toy would be realized. To be changed are the following: a dual axis of motion design, an ease of access outer shell design, a website that allows the customer to view live video from the webcams or security cameras, and a circuit board that is optimal in both size and usefulness.

We believe that Thomas Edison said it best when he said:

> *I have not failed. I've just found 10,000 ways that won't work.*
> -Thomas A. Edison

Although we did not accomplish what the original concept set out to do, this project taught us what working as a team is about, how to critically think, how to find answers and ask questions, and finally, what it means to see the big picture.